

Effect of elimination of diseases on expectation of life in Bangladesh

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Abstract

Purpose – The purpose of this paper is to investigate the trend of life expectancy in Bangladesh and find the effect of eliminating the causes of diseases on life expectancy statistics.

Design/methodology/approach – Data consisted of 1,530 deaths in 2000, 1,582 deaths in 2004 and 1,514 deaths in 2008 that were collected from the Health and Demographic Surveillance System of International Centre for Diarrheal Disease Research, Bangladesh. Trends in life expectancy after eliminating the cause of diseases were examined by a Single Decrement Life table.

Findings – The expectation of life for both male and female presented differing patterns. Results showed that life expectancies were greatly reduced in the presence of all groups of non-communicable diseases (NCDs) in the community, whilst life expectancies were significantly improved if all NCDs within all disease groups were completely eliminated. The life expectancies in the presence of NCDs showed lowest expected years among all the present diseases groups and the life expectancies eliminating NCDs showed highest expected years among all the eliminating diseases groups. The results indicated that 10.99 years of life would be added to life expectancy at birth for the male population and 8.82 years for the female population in 2008 if NCDs were eliminated.

Originality/value – The findings of this study provide useful information which could contribute to a more effective allocation of targeted funding for developing public health programs. Lowering mortality by eliminating major groups of diseases results in higher life expectancy ratings. Specifically, the relative impacts of eliminating cardiovascular diseases and respiratory diseases, as compared with eliminating neoplasms.

Keywords Bangladesh, Elimination of diseases, Expectation of life

Paper type Research paper

Background

Expectation of life is an important tool to measure the health condition of a country. By analyzing the elimination of major diseases, it is possible to improve our health and increase our life expectancy. Furthermore, by studying the effects of eliminating diseases, it is then possible to identify the diseases that more need to be controlled and more effectively utilize funds in the health sector for the more urgent needs of improving the society's life expectancy ratings. Every nation likes to increase the quality of health and life expectancy. For this reason, it is necessary to remove the avoidable causes of mortality to ensure the healthy life of all people. The last half of the 1990s showed that the life expectancy of 60+ years old was increasing and the average life expectancy rate reached 70 years in 2010. Life expectancy rate is higher among females than males in Bangladesh[1].

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The association between individual income and remaining life years at the statutory retirement age (65) was studied in the Netherlands during 1996–2007. It was also found that the remaining life expectancy at age 65 was approximately 2.5 years less for low-income individuals than that for high-income individuals[2]. A life-table analysis was used to estimate gains in life expectancy of the population. It was estimated that physical inactivity caused more than 5.3m of the 57m deaths that occurred worldwide in 2008. Furthermore, the elimination of physical inactivity would add 0.68 years to the life expectancy of the world's population. A 10 percent improvement in a physically inactive population would save 533,000 lives[3].

The effect of obesity on life expectancy was examined and compared between low and the high-income countries in a previous study. The result concluded that in many cases, mortality can be associated with excessive obesity. The result established that for age group 60+, the mortality risk due to obesity and overweight was higher in Mexico than the USA. In Latin American countries, the rapid growth of obesity and overweight occurred jointly with poor socioeconomic conditions. Furthermore, it was found that there was a gap in education levels between these two countries[4].

In a study conducted among the population in Ghana, it was found that between about one-fourth and one-third of all deaths could be attributed to malaria. Furthermore, almost 45 percent of the deaths due to malaria occur among children. If malaria was eliminated, life expectancy at birth would be expected to increase by more than six years for the population[5].

In another study conducted in China, the effects of eliminating cerebrovascular death on life expectancy were examined. Significant differences in statistics were found between rural and urban people. It was found that the loss of life expectancy was 2.26 years in 2010 and 0.04 years in 2005. The risk was highest for people of 40+ years. Urban community residents showed decreasing trends and rural residents showed increasing trend for cerebrovascular deaths[6]. Similarly, in a study conducted in Bangladesh too, diarrheal and infectious diseases appeared to be the major causes of low life expectancy within the population. If one is able to eliminate diarrheal and infectious diseases from this community, expectation of life will be increased by about 3 years at birth[7].

With the help of life table, the years of life gained by elimination of the specific causes of death were calculated for the USA in 1939–1941. Potential years of life gained by simultaneous elimination of several causes of death were discussed in that report. An abridged life table of the USA in 1959–1961 was also prepared on the basis of the assumption that malignant neoplasm is eliminated. It showed that if cancer was eliminated, 2.27 years of life would be added to the average life expectancy age[8].

Similarly, the mortality data of New South Wales during the years 2000–2002 were studied. The result showed that if diseases of the cardiovascular system for people aged 65+ years, malignant neoplasm for people aged < 65 years, and accidents, injury and poisoning, mainly for men aged 15–29 years were eliminated, then life expectancy would increase substantially. If cases of ischemic heart disease (IHD) were eliminated, then 7.5 years for males and 6.7 years for females could be added to their life expectancy at birth[9].

Cupola functions were used for potential dependence between heart disease or cancer and other causes of death. Another tool, correlation coefficient, was used to find the dependence structure. It was found that life expectancy at birth would increase by 3 months to 6.5 years if cancer mortality was eliminated, and by 5 months to 7.5 years for the elimination of heart disease[10].

It was stated that life expectancy at birth of Japanese people is now the longest in the world. To examine the effect of elimination of diseases and injuries, the Japanese national health statistics data were studied in 2007. It was found that life expectancy at birth was 79.2 years for males and 86.0 years for females. After eliminating malignant neoplasms, IHD and cerebrovascular diseases, people gained 0.6–4.0 years and for the other three diseases and injuries, people gained only 0.0–0.1 years[11].

Following the effective use of similar research in other countries to better understand statistics for life expectancy, the aim of this study was to investigate the trend of life expectancy in Bangladesh and find the effect of elimination of causes of diseases on the expectation of life.

Methods

The International Centre for Diarrheal Disease Research, Bangladesh (ICDDR, B) is an international health research organization which provides cause-specific, age-specific and gender-related mortality data. The data used in this study are from ICDDR, B. For this study, we used the vital registration and maternal and child health data gathered in 2000, 2004 and 2008. Abridged Life table, Single Decrement Life table and a Polynomial regression model were used in this paper[12].

e_x^0 indicates the expected (average) number of years of life left for a person aged x . For the l_x people alive at age x , the total number of years left for them to live is given by T_x . Therefore, on average, each of these l_x individuals has approximately T_x/l_x years to live. Hence, e_{ix}^0 indicates the expected number of years left for a person aged x in a specified cause of deaths, i . Thus, for the l_{ix} people alive at age x , the total number of years left for them to live is given by T_{ix} . Therefore, on average, each of these l_{ix} individuals has approximately T_{ix}/l_{ix} years to live[14]:

$$e_x^0 = \frac{T_x}{l_x}, \quad e_{ix}^0 = \frac{T_{ix}}{l_{ix}}.$$

Hence, similarly:

$$e_{(-i)x}^0 = \frac{T_{(-i)x}}{l_{(-i)x}}.$$

The polynomial regression model is used to determine the yearly trend in the number of deaths caused by non-communicable diseases (NCDs). The underlying model corresponding to each variable is as follows:

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 X_i^2 + \beta_3 X_i^3 + \dots + \beta_p X_i^p + e_i,$$

where X_i is the year, Y_i indicates the number of deaths due to NCDs and e_i indicates the error terms[13].

Ethics approval

The study was approved by the University Research Ethics Committee (No. 0089, date: December 6, 2011), Department of Statistics, University of Rajshahi, Bangladesh.

Results

From Table I, it is observed that life expectancy in Bangladesh has been increasing. The increasing trends are both for male and female. In the years 2000–2004, 0.49 years were added to the life expectancy at birth for females, whereas for male persons, 0.76 years were added. Life expectancy increased a further 1.86 years for males from 2004 to 2008, which was approximately twice the previous increment. For females, it increased by 2.70 years from 2004 to 2008, which was approximately six times greater than the previous year. So, life expectancy of females grew faster than for males. The life expectancy at birth in the year 2000, 2004 and 2008 were 63.95 and 67.00, 64.71 and 67.49, and 66.57 and 70.19, for males and females, respectively. This indicates that life expectancy rates were higher among females.

From Table II, it is interesting to better explain $e^0_{(1)x}$ and $e^0_{(-1)x}$ for males in 2008. If maternal and neonatal causes (D1), communicable causes (D2), non-communicable causes (D3) and miscellaneous causes (D4) were all eliminated, then the life expectation for a male at birth would be 82.14 years. $e^0_{(-1)x}$ means that if D1 was eliminated and D2, D3 and D4 were the cause of death, then the expectation of life of male at birth was 67.83 years. The study found that $e^0_{(i)x}$ was 82.14, 82.16, 70.77 and 81.97 years, respectively, for D1, D2, D3 and D4 for males in 2008. This suggests that D3 was the most influential life expectancy factor. If only D3 was present and the remaining causes were eliminated, D3 alone would lower the expectation of life to 70.77 years, whereas for the single presence of other diseases, the expectation of life was around 82 years. Also it is observed that $e^0_{(-i)x}$ was 67.83, 67.28, 77.56 and 67.58 years, respectively, for eliminating D1, D2, D3 and D4 for males in 2008. It reaffirmed that D3 was the most influential factor. If only D3 was eliminated and the remaining causes were present, the elimination of D3 alone raised the expectation of life to 77.56 years, whereas for the single elimination of other causes of deaths, the expectation of life was around 67 years. It was also noted that females are expected to live longer than males. So, if we want to eliminate a single cause of death to maximize the expectation of life, we have to eliminate D3 because D3 is becoming more influential from year to year.

Figures 1 and 2 depict the trend of expectation of life eliminating the effect of a single cause of deaths among the male population. The elimination of the first cause of reduced life expectancy, namely, neonatal and maternal causes, showed slow increasing trend in life expectancy. The second cause, communicable diseases, and the fourth cause, injuries and miscellaneous, offered similar pattern, whereas the third cause, NCDs, showed a significant rising trend.

From Table III, it is found that the life expectancies in the presence of NCDs showed the lowest expected years, whilst the life expectancies eliminating NCDs showed the highest expected years.

The highest expected years of life were recorded in the year of 2008 for both sexes. Furthermore, it was observed that the expectation of life had increased significantly in recent years in comparison to the past years. The upward trends indicated that the life expectancy ratings for females were higher than for males (Figure 3).

Figure 4 expresses the effect of eliminating NCDs. The expectation of life at birth was increasing due to the elimination as the years passed by. It revealed that NCDs were becoming more significant. In the comparison of years, the highest expected years of life

Table I.
Life expectancy for male and female starting at zero age

Expectation of life	Year 2000	Year 2004	Year 2008	Absolute difference from 2000 to 2004	Absolute difference from 2004 to 2008	Absolute difference from 2000 to 2008	Relative difference from 2000 to 2004	Relative difference from 2004 to 2008	Relative difference from 2000 to 2008
For male	63.95	64.71	66.57	0.76	1.86	2.62	1.19	2.87	4.10
For female	67.00	67.49	70.19	0.49	2.70	3.19	0.73	4.00	4.76

Table II.
Life Expectancy in specified causes of deaths (D_i) eliminating the effect of other causes of deaths for both sexes in different years

Sex	Year	$e^0_{(1)x}$	$e^0_{(-1)x}$	$e^0_{(2)x}$	$e^0_{(-2)x}$	$e^0_{(3)x}$	$e^0_{(-3)x}$	$e^0_{(4)x}$	$e^0_{(-4)x}$
Male	2000	81.01	65.99	77.79	67.32	76.00	68.29	76.33	68.20
Female	2000	79.50	70.26	81.10	68.64	78.40	69.99	76.80	71.39
Male	2004	81.76	66.19	81.47	65.51	69.99	75.33	80.52	66.22
Female	2004	81.15	69.46	82.83	67.80	72.66	76.11	80.65	68.97
Male	2008	82.14	67.83	82.16	67.28	70.77	77.56	81.97	67.58
Female	2008	82.72	70.94	82.95	70.70	73.55	79.01	82.13	71.18

was seen in 2008 for both males and females: 77.56 years for the males and 79.01 years for the females in the year 2008. So, the elimination of NCDs was becoming more important than ever.

Discussions

Life expectancy is usually the measure of the expectation of life at birth. The life expectancy at birth highlighted minor increases until the 2004s and during this time, life expectancy increased rapidly from the year 2004 to the year 2008. The result was in agreement with those of Ismail *et al.*[14] who reported that increased life expectancy in Bangladesh during the twentieth century was a significant achievement for the nation.

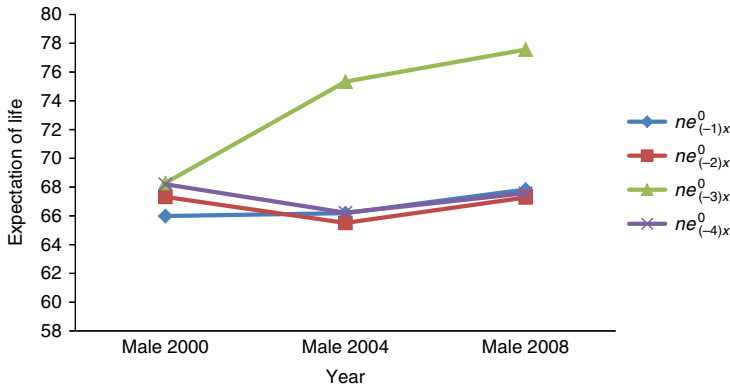


Figure 1. Life expectancy in specified causes of deaths (D_{ix}) eliminating the effect of a single cause of deaths for the male population in different years

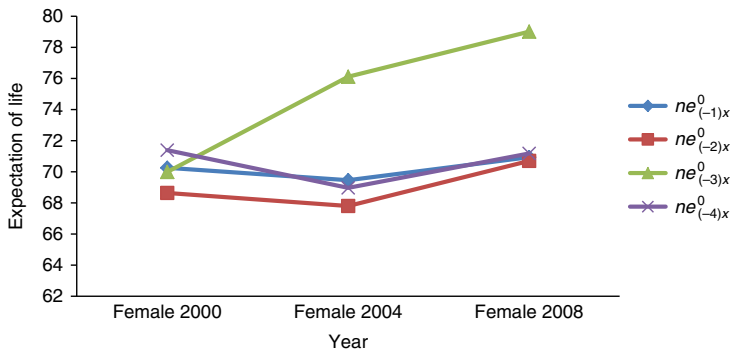


Figure 2. Expectation of life in specified causes of deaths (D_{ix}) eliminating the effect of a single cause of deaths for the female population in different years

Note: Figure 4 shows similar patterns among the female and male populations

Sex	Year	$e'_{(1)x}$	$e'_{(-1)x}$	$e'_{(2)x}$	$e'_{(-2)x}$	$e'_{(3)x}$	$e'_{(-3)x}$	$e'_{(4)x}$	$e'_{(-4)x}$	e^0_x
Male	2008	15.57	1.26	15.59	0.71	4.20	10.99	15.4	1.01	66.57
Female	2008	12.53	0.75	12.76	0.51	3.36	8.82	11.94	0.99	70.19

Note: Difference of expectation of life in specified cause of deaths (D_{ix}) eliminating the effect of other causes of deaths for both sexes in different years from observed life expectancies

Table III. Expectation of life

Figure 3.
Expectation of life for both sexes by different years

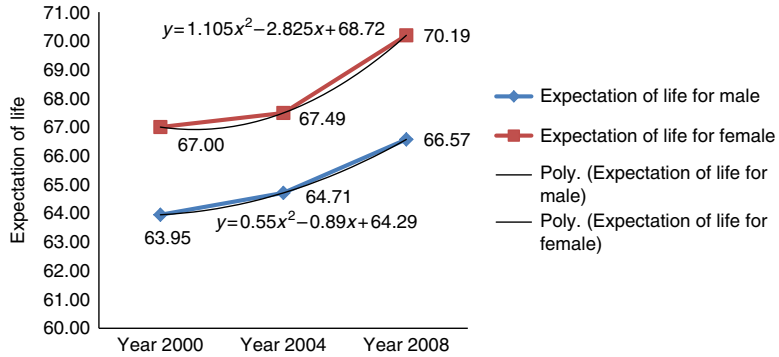
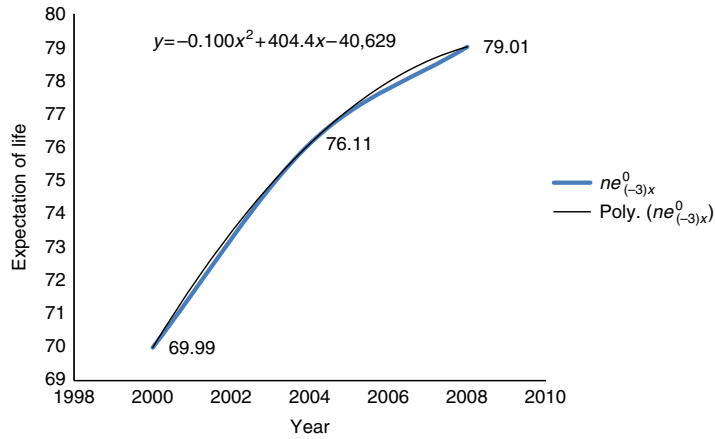


Figure 4.
Expectation of life in eliminating non-communicable diseases (D_3) in the presence of other causes of deaths, for female population in different years



We observed that in the year 2000 to the year 2004, life expectancy years were only 0.49 years for female at birth, whereas for male persons, this was increased to 0.76 years. Furthermore, life expectancy increases 1.86 years from 2004 to 2008 for male which was approximately two times greater than the previous years 2000–2004 and also increases 2.70 years from 2004 to 2008 for female which was approximately six times greater of the previous years 2000–2004. The life expectancy at birth in the year 2000 was 63.95 for male and 67.00 for female which indicated that life expectancy was higher for female than males. In addition, the average remaining life time (in years) for a person who survived to the beginning of the indicating age interval was 64.71 for males, whereas it was 67.49 for females in the year 2004. For the year 2008, the expectation of life for males was 66.57 on an average and for female it was 70.19 years on an average. This indicates that life expectancy among females grew faster than their male counterparts. This result supported the reports of Van Oyen *et al.*[15] and Barford *et al.*[16].

The highest expected years were recorded in the year of 2008 for both sexes. It was clear that the polynomial of degree 2 gave the best fit as a model for life expectancy trend. The polynomial could explain the year variation in the expectation of life when the quadratic model was applied to the male and female groups. It was observed that the expectation of life at birth increases in recent years compared to past years. The upward trends indicated that the rate of change was significantly high for females.

The expectation of life at birth for males was found to be highest (82.16 years) due to communicable category in 2008, whereas it was 82.95 years for female in the year 2008 considering the same cause of death. If we eliminate the NCDs, it was noticed that the life expectancy reached at 77.56 years for male in 2008 and it reached at 79.01 years for female in 2008 which was highest among the eliminating groups. A remarkable difference of nearly two years in the male–female expectation of life at birth due to non-communicable category was found. It testified that the more we control NCDs, the greater was the increase in expected years of life at the highest degree among all groups of diseases. It was almost 8 years (for male) and 10 years (for female) more than other groups in 2008 as seen from Dublin *et al.*[8] and Manton *et al.*[17] but they eliminated different types of diseases and also added some years in life expectancy.

After eliminating NCDs, the trend of life expectancy showed increasing variable patterns for both male and female. Also, if we take NCDs as a specified category, the trend of expectation of life offers decreasing patterns. This indicated NCDs as the leading cause of death with little difference between males and females. The rate of change of life was high among the female population in the case of NCDs.

Conclusion

The expectation of life showed increasing trends over the year and life expectancy was high for female more than male. The life expectancies in the presence of NCDs showed lowest expected years among all the present diseases groups and the life expectancies eliminating NCDs showed highest expected years among all the eliminating diseases groups. The gain in life expectancy at birth had the highest values (male: 10.99 and female: 8.82) due to NCDs elimination in 2008. Every nation wants to improve the health level of its population. So, it is important to make the necessary plans to eradicate those diseases that attack people the most and ensure the healthy life of the people.

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